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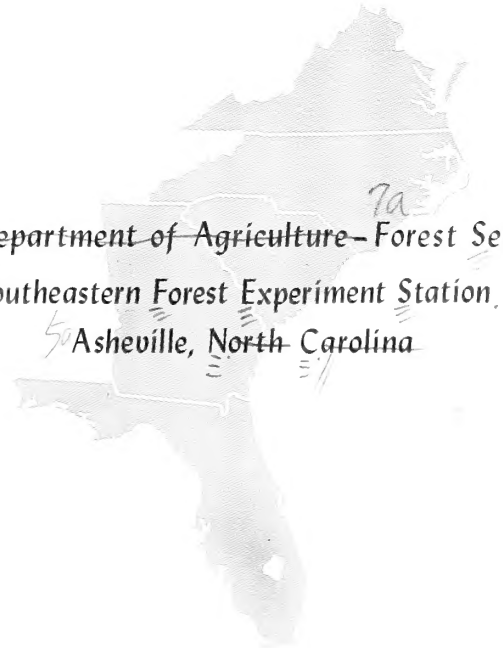
A Guide to Grading Features in Southern Pine Logs and Trees

by

Robert A. Campbell



U.S. Department of Agriculture–Forest Service
Southeastern Forest Experiment Station
Asheville, North Carolina

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INTRODUCTION

The measure of quality of a log or tree is dependent on the products it will yield. For example, lumber is greatly affected by such gross characteristics of the tree as limbs, knots, conks, sweep, scars, etc.

This guide is offered as a help in understanding these characteristics and their effect on the type of lumber and 2-inch dimension material produced from southern pine logs. Specifically there were four major species studied: Slash pine (Pinus elliottii), loblolly (P. taeda), longleaf (P. palustris), and shortleaf (P. echinata).

Southern pine log grades [1/] have been developed during the past 15 years of study and have been approved for Forest Service use. This guide is supplemental to the grading system and is intended as an aid to the application and use of these log grades. Unless otherwise stated, the degrading and other features described in this guide apply over the entire commercial range of southern pine. The only end product to which the log grades and this guide apply is lumber, in the standard grades and sizes including 2-inch dimension, as defined by the Southern Pine Inspection Bureau. [2/] It does not include stress-graded material.

To apply log grades consistently and accurately, a buyer, seller, or other user must fully understand which of the surface blemishes is a log defect and how important it is. Blemishes have been divided into two major classes as follows:

1. Degrading features.
2. Non-degrading features.

The first category--degrading features--was established because the presence of one or more of these items in a log will lower its value when it is sawed into lumber. A good example is the large knot. The items in the

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1/ Specifications are now available from the Southern or Southeastern Forest Experiment Stations in handy pocket form and are entitled, "Forest Service Standard Grading System for Southern Pine Yard Lumber Logs."

2/ See "Standard Grading Rules for Southern Pine Lumber," published annually by the Southern Pine Inspection Bureau of the Southern Pine Association, New Orleans, Louisiana.

second category, non-degrading features, do not degrade the log or tree even though they may reduce volume, as in the case of fire or lightning scars. Each of these categories is described and illustrated in the following text.

Many of the words used in log grading have a number of different meanings and usages, even within the field of forestry. In order to minimize confusion, the following basic definitions apply in this guide and in the log grade specifications the guide supplements.

A log degrading feature is an imperfection (usually visible on the surface) which lowers the quality of the lumber produced from the log. (In contrast, an imperfection in the lumber is called a lumber defect.) In southern pine these degrading features are limited to knots, conks, and excess sweep. Scaled deductions are made for rot and excess sweep but not for knots.

DEGRADING FEATURES OR IMPERFECTIONS

Most log imperfections are related to lumber defects in the underlying wood. Since lumber is the only product considered in these yellow pine log grades, the most important log imperfections are those which directly and consistently influence the quality of the lumber. They include all imperfections which relate directly to knots (lumber defects in the underlying wood), such as limbs, stubs, holes, overgrowths and unsound knots. They also include excessive sweep (as defined in the specifications), and wood-rotting hyphae. Even though scaling deductions are not made for log knots and overgrowths, they are made for rot, and for sweep if excessive.

The various log-surface abnormalities common to southern yellow pine are discussed individually and grouped in order of descending importance.

LOG KNOTS AND OVERGROWTHS

The term "log knot" is used to cover live limbs, dead limbs, stubs, and associated holes and overgrowths, rather than the lumber term "knot," even though we know that these imperfections will show up as knots in the lumber.

A limb is defined as a branch $\frac{1}{2}$ inch or larger in diameter growing from the stem of a tree. As used here it includes the stubs, holes, and overgrowths that follow the various stages of limb deterioration (fig. 1). Limbs, in this sense, are by far the most common and most important log defect found in southern yellow pine. Overgrowths are bark distortions showing definite breaks or alterations in the normal pattern of the bark. The most common are those associated with overgrown limbs or knots. These are usually circular in form and are sometimes called "puckers" (figures 2 and 3).

A limb, stub, or associated hole or overgrowth signifies a knot in the underlying lumber. Hence they are classed as degrading features--with the exception of adventitious limbs.

Although all limbs over $\frac{1}{2}$ inch in diameter are log degraders, their size influences their importance in log grades. Hence, it is necessary to recognize the types of knots and limbs and to standardize on measuring methods.

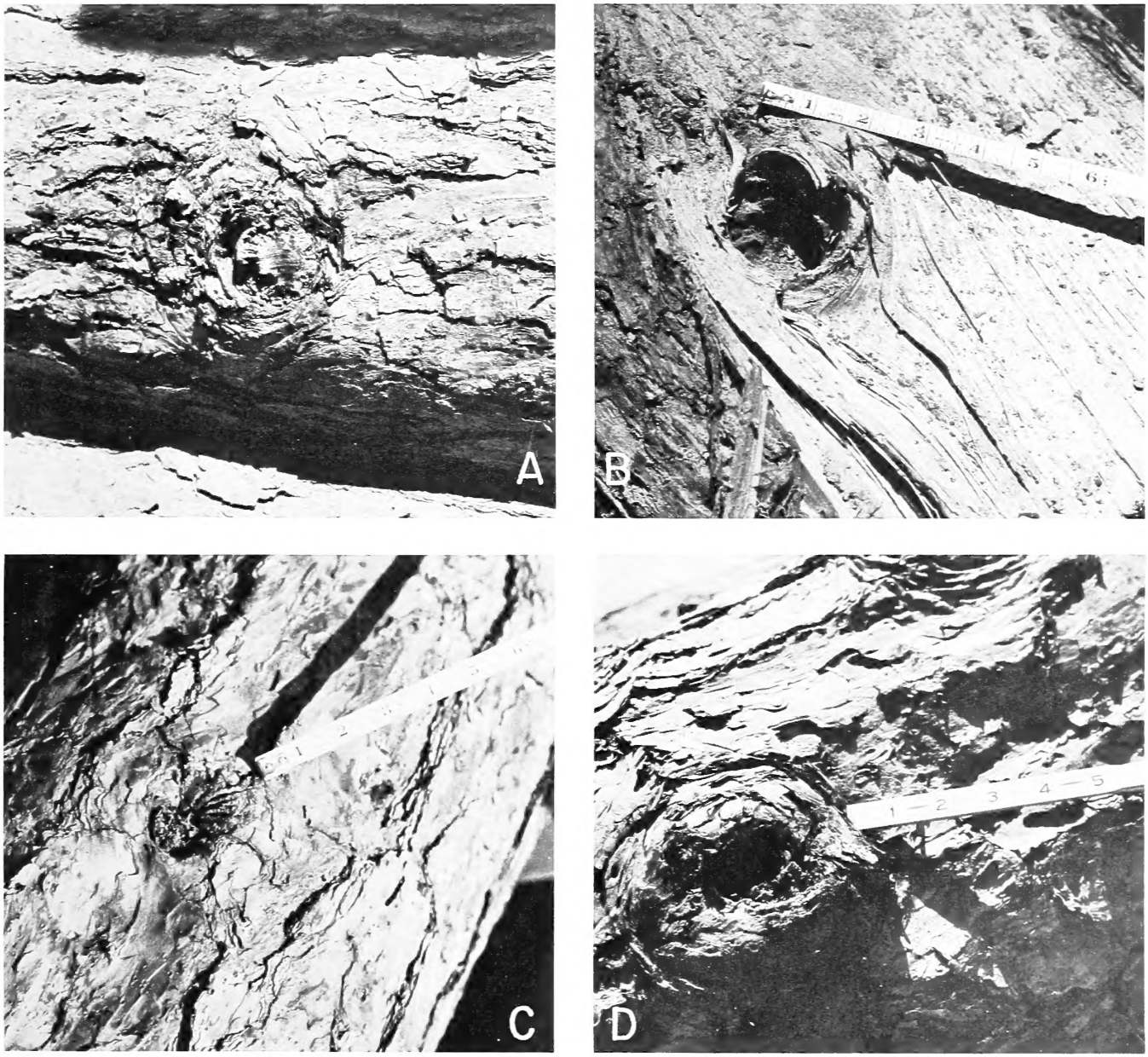


Figure 1. --Commonest degrading features are log knots. Here are examples of stubs and sockets. A shows a limb stub of recent origin. B is an old limb socket. C, new callus tissue forming around a limb socket. D, old callus growth around recently shed limb stub.

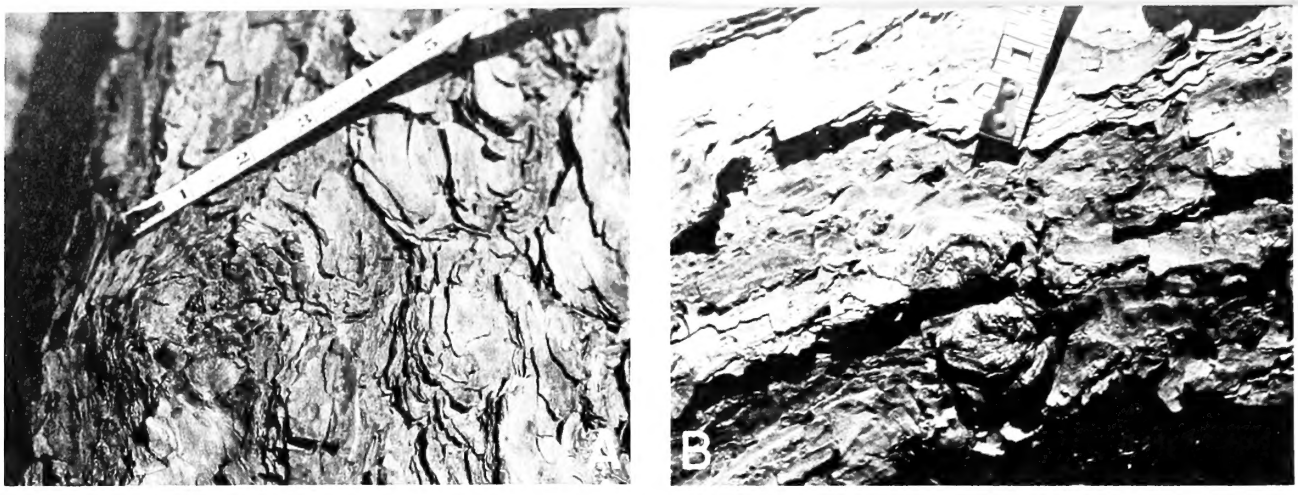


Figure 2.--Log knots showing up as overgrowths or puckers. A is an early-stage pucker. B shows a much later-stage overgrowth.

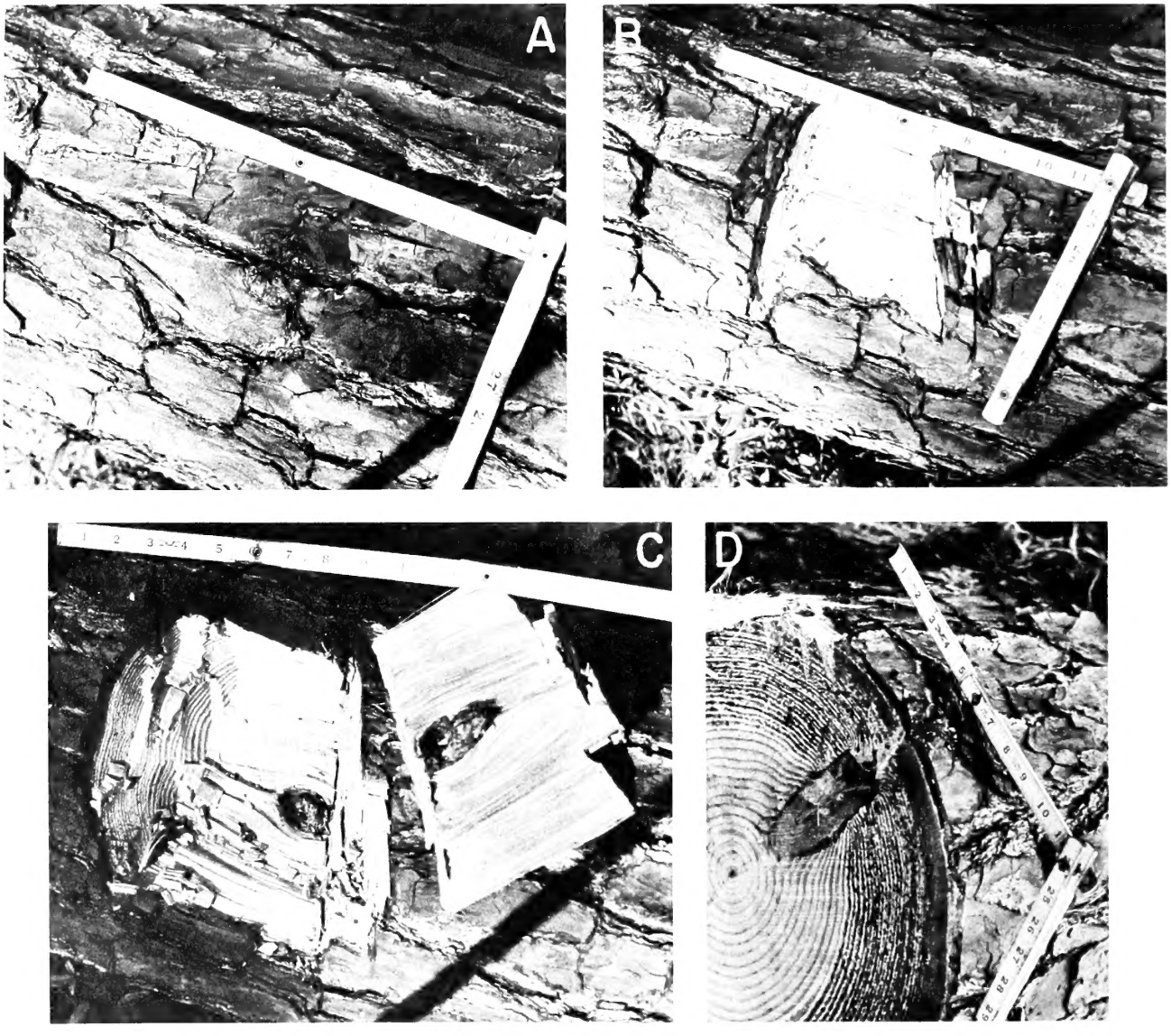


Figure 3. --These photos illustrate product defect that may underlie small overgrowths or puckers. A is a typical limb overgrowth. B shows clear wood 1 inch below surface when A has been chopped off. C, same overgrowth $2\frac{1}{2}$ inches below surface. D, an overgrown knot on log end, showing surface pucker despite depth of clear wood over stub.

Limb and Log Knot Measurements

Live limbs. --Measure the size of a limb near its junction with the tree trunk. Do not include the swelling commonly present at the limb collar. Measure limb diameter outside bark to the nearest inch (fig. 4). All live limbs $\frac{1}{2}$ inch and over are grading defects. Adventitious limbs (being smaller) do not degrade a log.

Dead limbs are generally measured in the same way as live ones. If, however, only a portion of the original limb stub remains and size is important, estimate its diameter (inside the surrounding callus tissue) to the nearest whole inch. Limbs or stubs unsound because of rotten sapwood are also measured or estimated as though sound--to the nearest whole inch (fig. 5).

Overgrowths are the remaining evidence on the log surface of a defect covered by callus tissue (fig. 2). Those with a characteristic circular bark pattern are frequently called "puckers" (fig. 3). These bark distortions are most commonly associated with overgrown log knots. Sometimes an overgrowth resulting from a logging scar or other damage will be irregular in shape, in contrast to circular ones covering old log knots.

Unsound log knots are either: (a) those with visible rot (which extends into the log), or (b) those surrounding a hole which extends two or more inches below the bark. Although they appear innocuous they usually indicate decay inside the log (fig. 6).

Oversize log knots are any sound log knots with an average diameter larger than 1/6 the scaling diameter of the log (fig. 7).

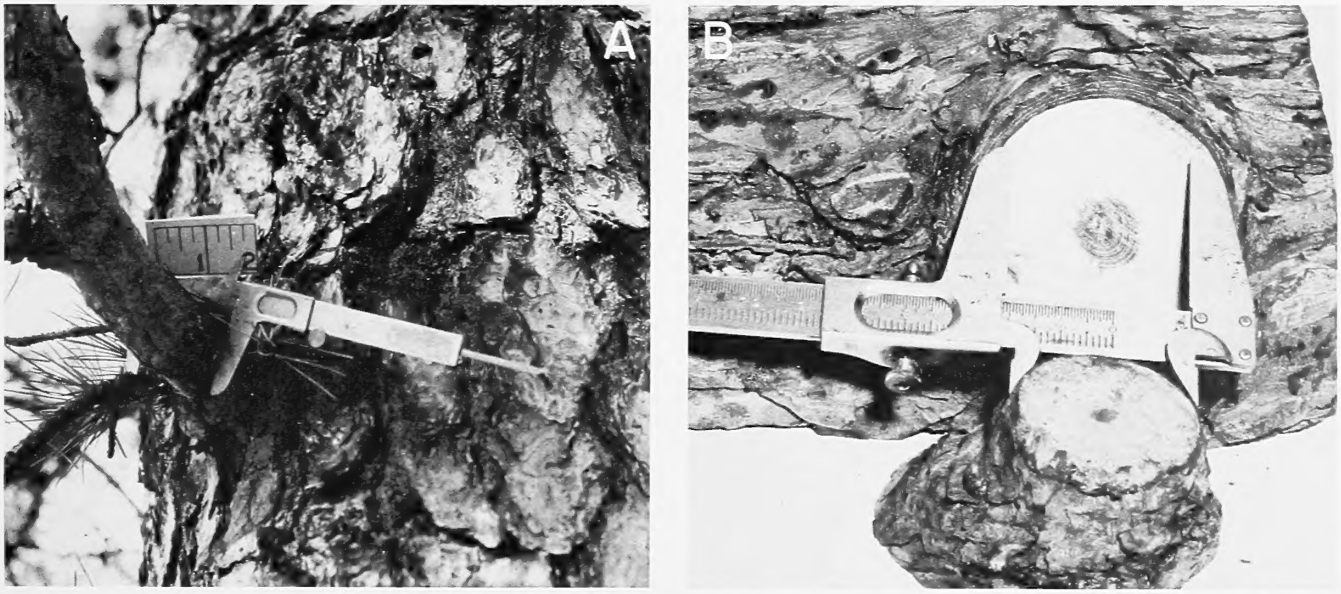


Figure 4. --Limb and knot measurement. A, live limbs are measured as indicated here, to the nearest inch of diameter; do not include the bark callus where limb joins trunk. B shows relation of limb size to trimmed knot size; hence if knot is measured after trimming, include only the surface area enclosed by circular annual rings and not all of the exposed wood.

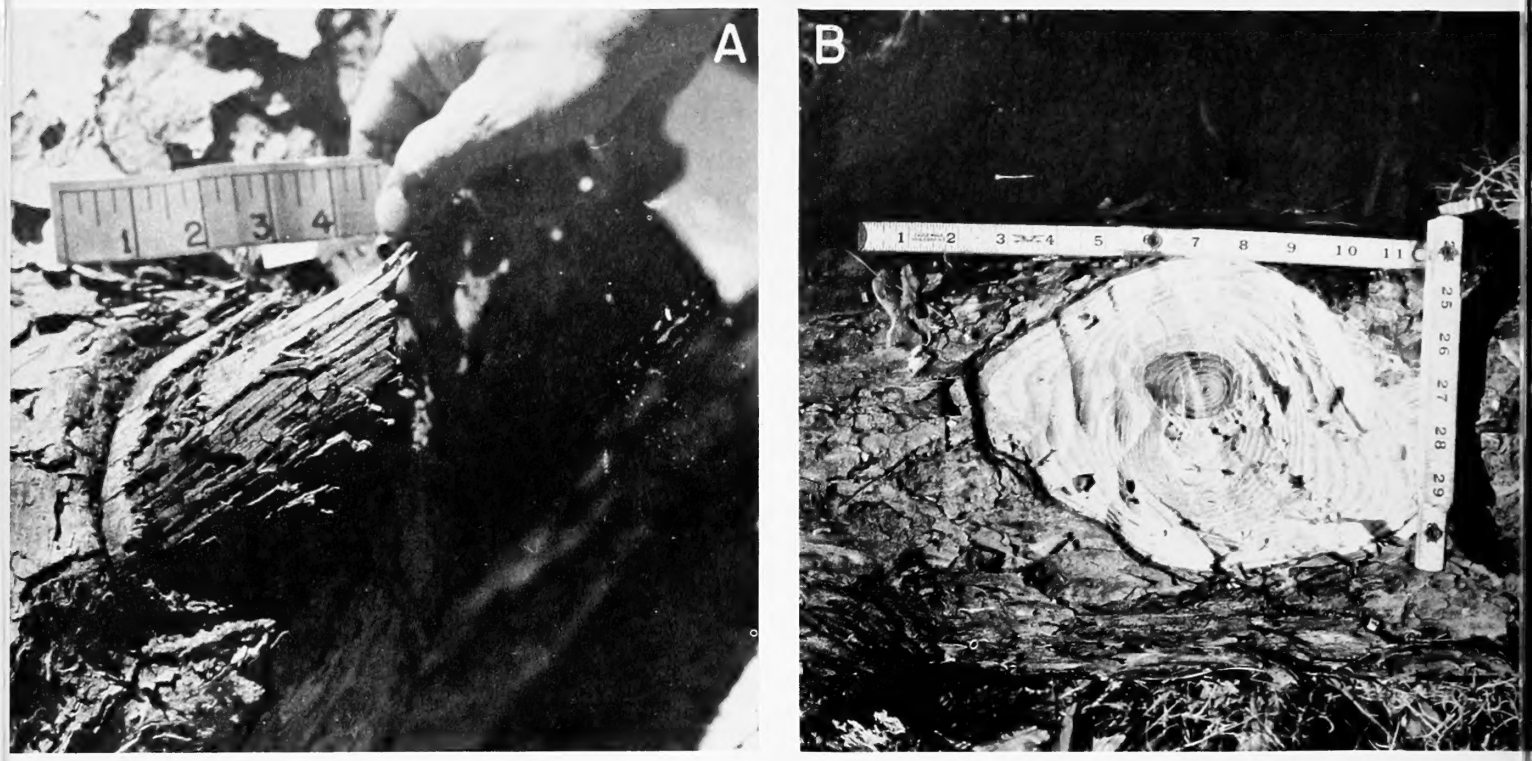


Figure 5. --Log knots resulting from dead limbs. A, sound limb stubs often appear rotten. B, when limb stub shown in A has been trimmed flush, note that all exposed wood is sound.

Multiple log knots are more common on old trees. They look like more than one knot, but sectioning will show them coming from one original limb which has callused over and resprouted. Only the largest sprout or branch is counted (fig. 8).

Holes, large. --A special kind of degrader resulting from bird damage is the large round hole. This item is discussed here since it is a degrading feature, whereas small holes can be ignored. Sockets are holes resulting from broken limbs, and, if large enough, are also classed as degrading features.

A large hole is an unoccluded opening larger than $\frac{1}{2}$ inch in diameter which penetrates through the bark and 2 or more inches into the wood of a tree. Common causes are rotten limbs, and woodpeckers or animals excavating infected spots in search of insects or a den. Within the range of the cockaded woodpecker (North Carolina to Texas) these birds will sometimes drill nesting holes in apparently sound trees. According to ornithologists, however, they usually choose to "hole up" in a tree already infected with red heart, where the drilling tends to be easier (fig. 9).

Most large holes occur in the upper part of a tree, at least above the butt log. Rot is usually associated with them, either as a cause or as an aftereffect. The hole itself is obviously a lumber defect. These holes are circular in shape, in contrast to the unsound knot holes, which tend to elongate with age.

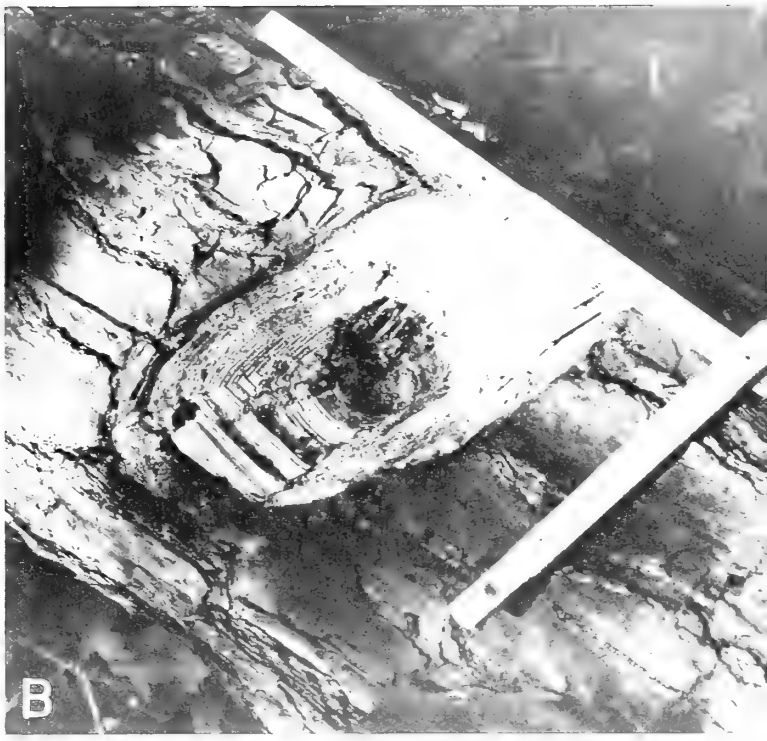
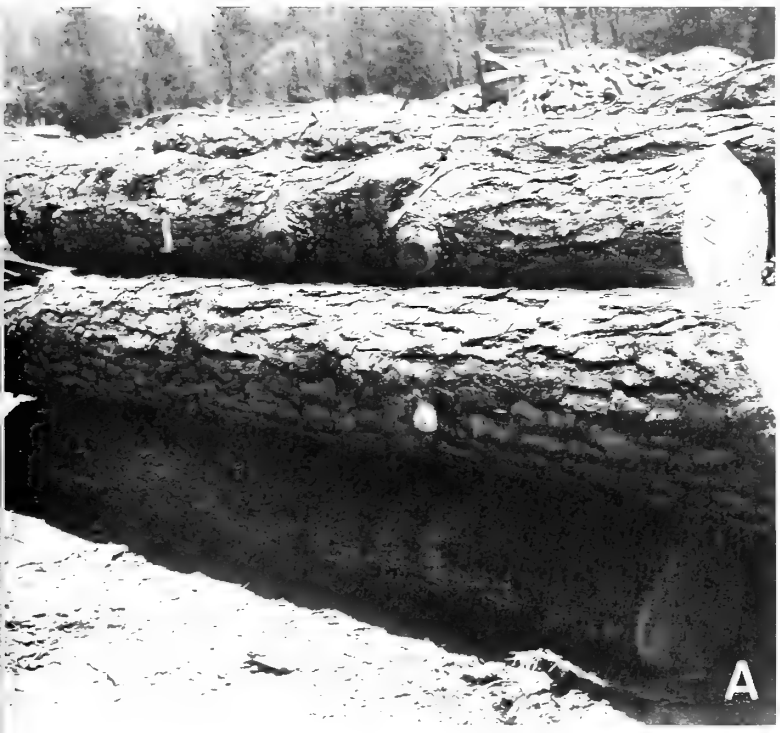


Figure 6. --Unsound knots are those with $\frac{1}{4}$-inch or larger hole penetrating 2 or more inches below log surface. Although they appear sound, they are usually rotten. A, depth and soundness should be tested by probing. B, as in A but 3 inches deep; definite decay evident.



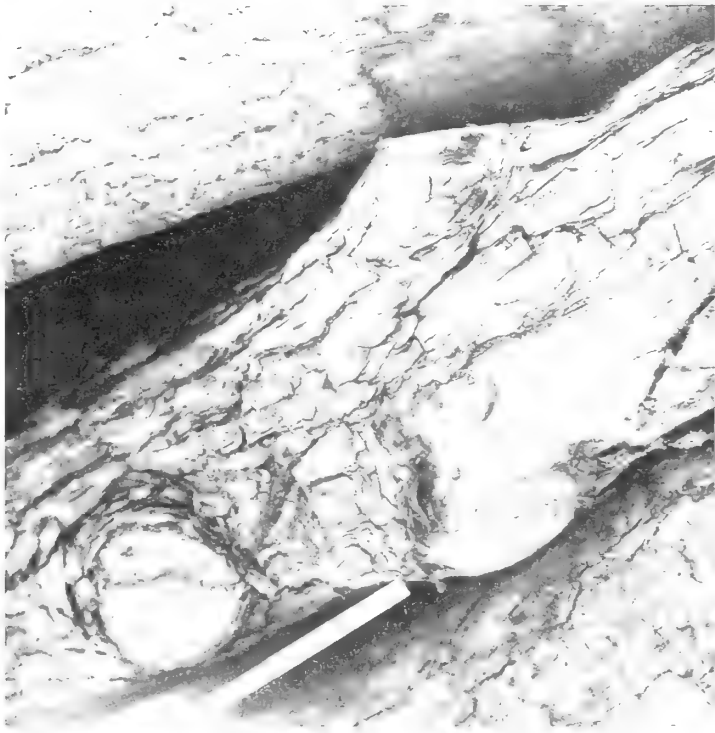


Figure 7.--Log knots are oversize when they exceed 1/6 log scaling diameter. A, oversize knots in center log reduce it from grade 3 to 4. B, closeup of degrade due to oversize knots.

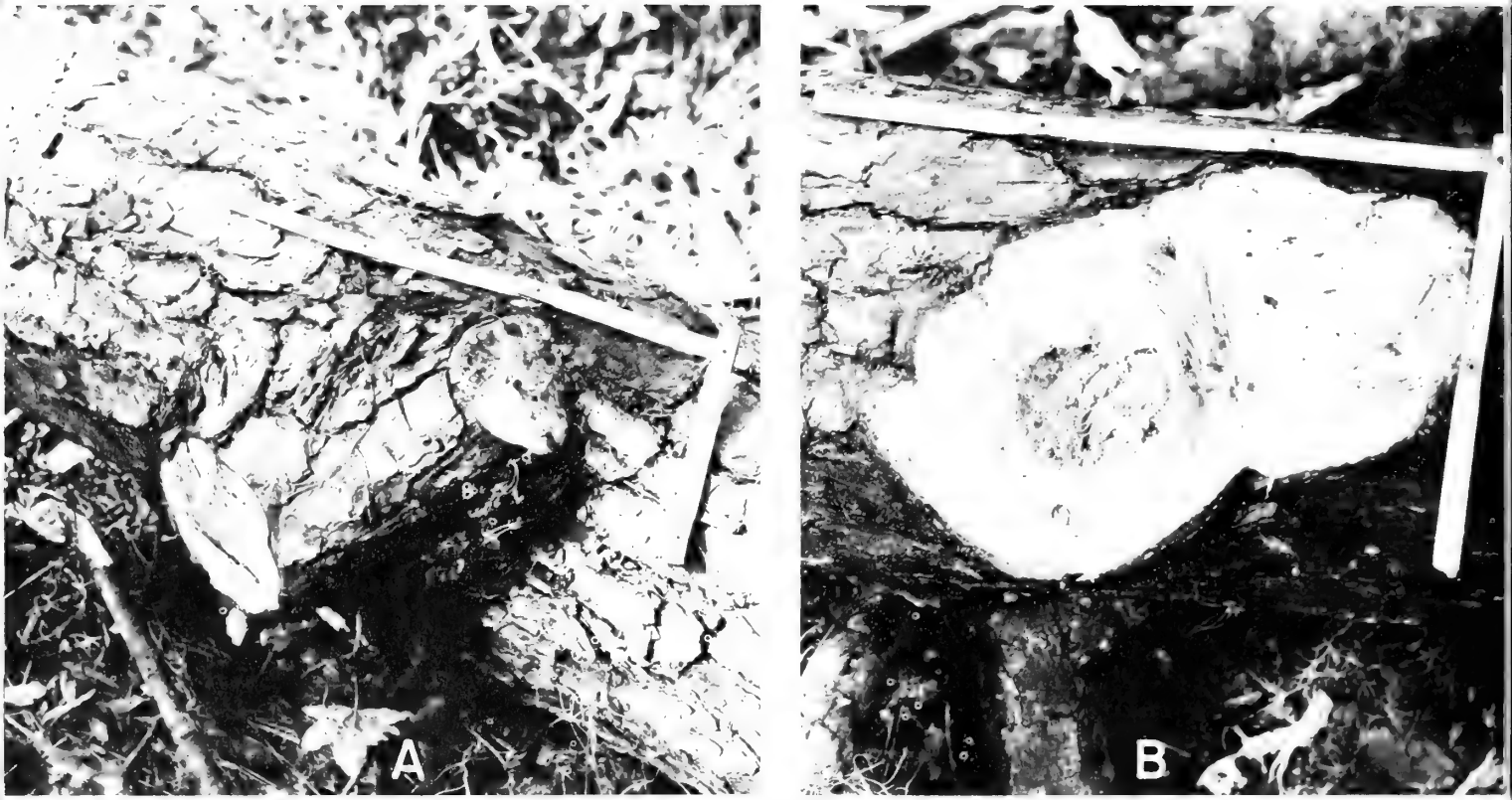


Figure 8. --A, a multiple log knot; the larger one only (on left) is counted or measured. B, the multiple knot at left opened up showing single knot effect on the lumber.

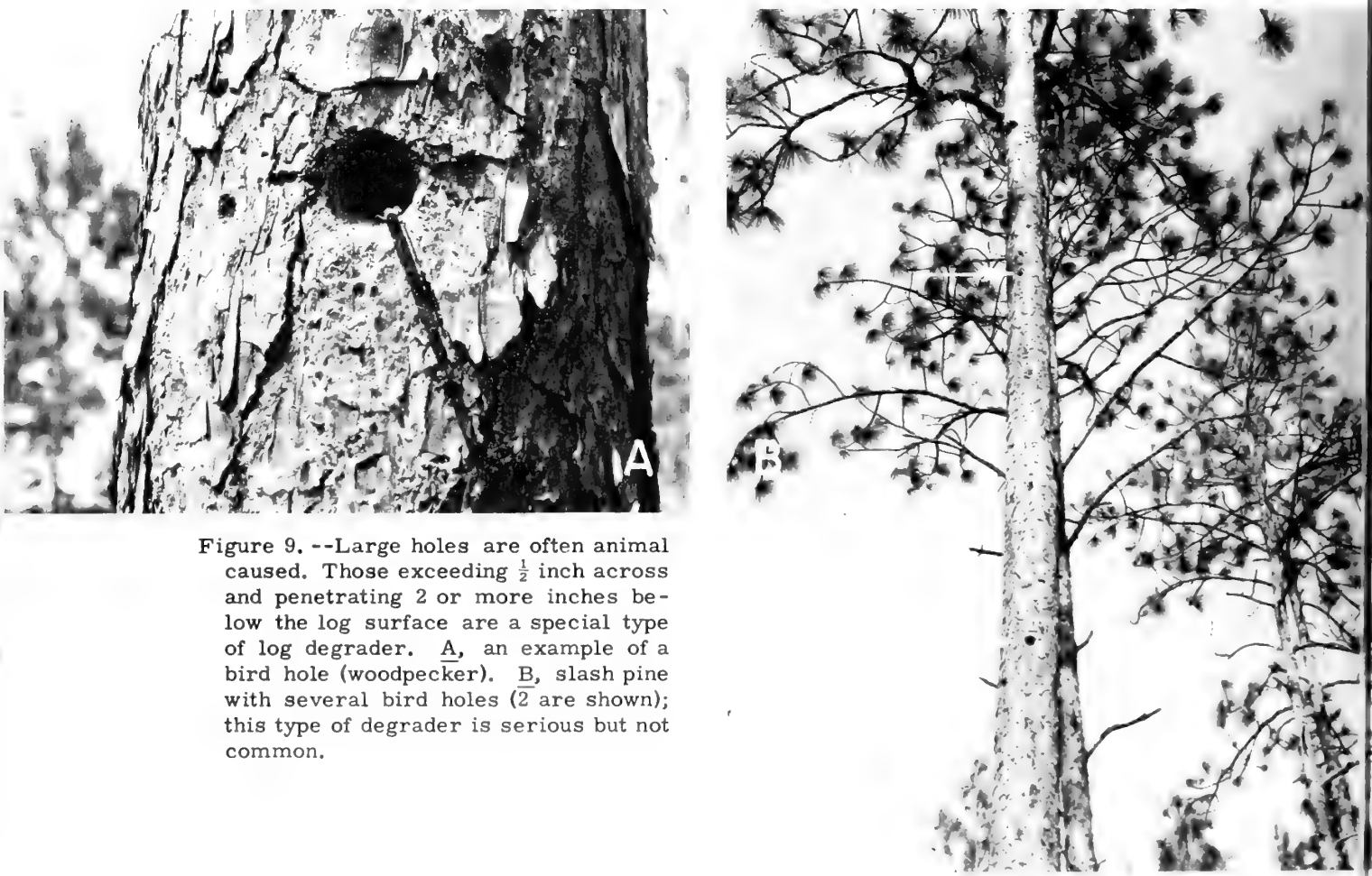


Figure 9. --Large holes are often animal caused. Those exceeding $\frac{1}{2}$ inch across and penetrating 2 or more inches below the log surface are a special type of log degrader. A, an example of a bird hole (woodpecker). B, slash pine with several bird holes (2 are shown); this type of degrader is serious but not common.

SWEEP (EXCESSIVE)

A gradual bend in a log or tree is called sweep, in contrast to a crook, which is an abrupt bend. Both originate when a tree is deformed by wind, snow, a falling limb or tree, or other mechanical cause, or when a tree suffers damage to its leader. They may also be caused by heredity. Sweep is specifically defined as the general deviation of the longitudinal log axis from a straight line connecting the geometric centers of the log ends (fig. 10). Sweep, in addition to being a scaling deduction if it exceeds the limits indicated below, results in a degraded log unless the log is already a grade IV.

When a sweepy log is sawed, the low-grade knotty core shows up in more boards than is the case with a normal log. The cross-grain effect weakens the lumber and creates machining difficulties. Compression wood, which is weak and surfaces rough, is also frequently associated with sweep. The net effect of serious sweep is lower-quality lumber due to the pith centers, cross-grain, low strength, and surfacing problems.

Proper log making in the woods can minimize the effect of sweep on quality. Sweep must equal or exceed 3 inches and 1/3 the log diameter to be called a log imperfection.

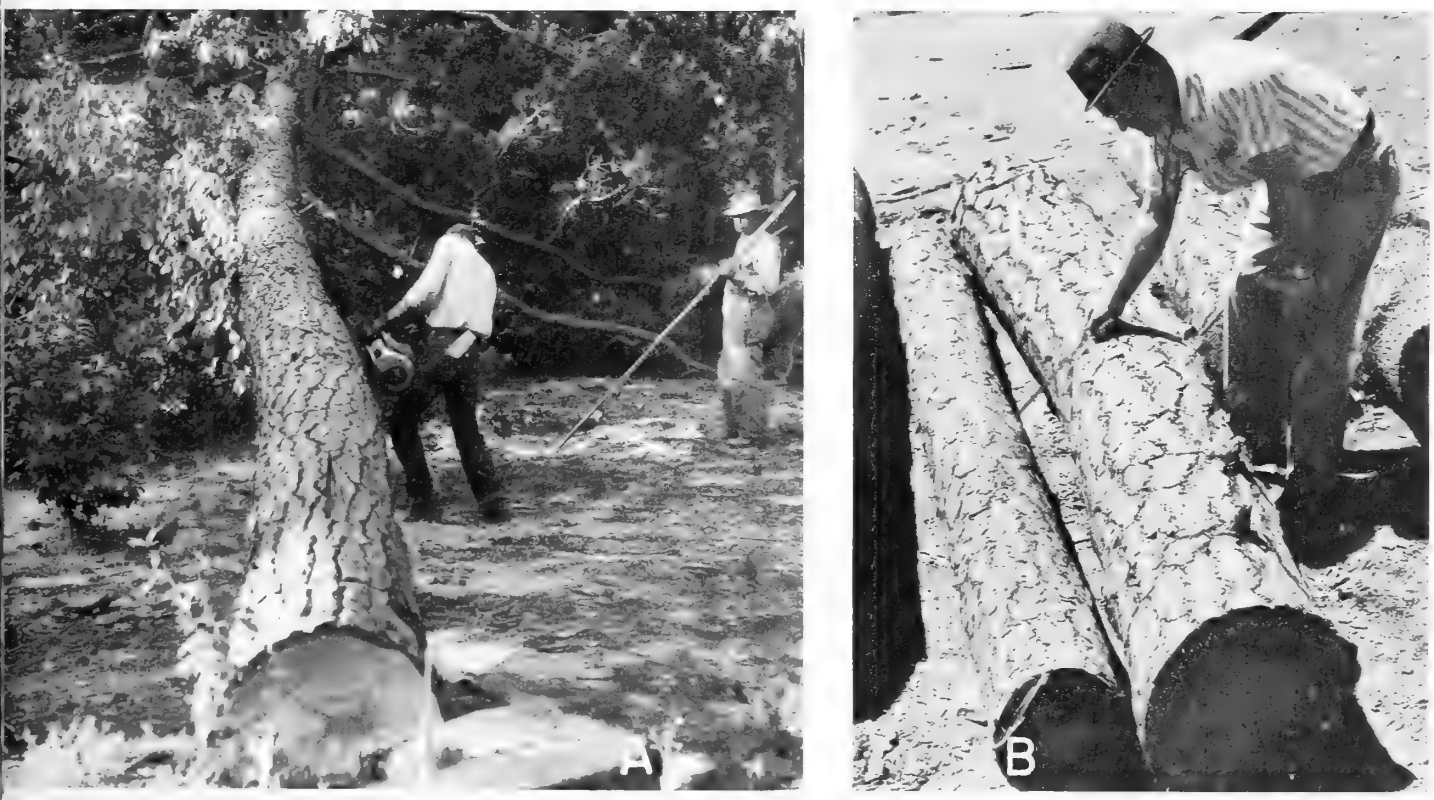


Figure 10. --Sweep, a frequent cause of degrade (if it exceeds 3 inches and 1/3 scaling diameter). A, in the tree, it can frequently be bucked out. B, in the log, it is too late for bucking to help.

CONK AND RED HEART

These are both forms of heart rot caused by the fungus Fomes pini (Thore) Lloyd. The conk is the fruiting body of the fungus contained within the tree (fig. 11A). It is a fibrous or fleshy protrusion of definite form and structure found on the bole of a pine tree. This fungus (and some others attacking yellow pine) gains entry through exposed heartwood, usually in broken-off or dead branches. Other evidence of this fungus is the punk knot--the knot with the nonfruiting fungus tissue (fig. 11B).

A conk signifies rot and the advance stage of decay. In yellow pine a conk usually marks a limb location, even if the limb is no longer visible. The extent of rot depends on the age of infection and the age of the tree. In any event, serious loss of volume and quality is indicated (fig. 11C), frequently to the point of rendering a log or tree unmerchantable. The presence of a fruiting body or punk knot piercing the bark surface of a log requires a reduction of one grade. Red heart alone without a conk or other signs is classed as a scalable item.

Figure 11.--Heart rot or red heart (Fomes pini) is always a degrader. Reduce log one grade when fruiting body or punk knot pierces bark surface. A, conk (sporophore) on trunk. B, punk knot--nonfruiting form of the disease. C, decay in the log; also shows probable access route through dead limb.

NON-DEGRADING FEATURES

In addition to the degrading features described above, other types of blemishes are classed as non-degraders. They don't lower the log grade but may lower the net volume. This group is further subdivided into scaled and non-scaled features.

Although not so vital in grading logs or trees as the degrading features, scaled features are still very important. Such items as cankers, scars from lightning, fire, or logging are included here.

SCALED FEATURES

Canker

A canker is a definite, relatively localized, partially open lesion, characterized in yellow pine by destruction and/or distortion of tissue, repeated callusing, and by pitch flow in varying amounts. The most common type of canker is cronartium. It and others sometimes serve as entry points for various rot-producing fungi.

A cronartium canker is easily recognized by the concave or "scooped-out" appearance of the lesion (fig. 12A, B). Accompanying lumber defects are due to the pitch (both massed and streaked) and to structural weakness from contorted grain.

Figure 12. --Canker caused by Cronartium. A, as observed in the tree; a degrader in this case because rotten heartwood is exposed. B, not a degrader here because heartwood is not affected. Usually a canker is a scale deduction only.

Other types of cankers are less easily characterized. Some are of fungus origin, but they can also be caused by such things as frost, sun scald, and other wounds. Once an open lesion is produced, however, the entry of disease organisms frequently follows, and the typical pattern of tissue destruction and callus formation develops. Some cankers resemble burls or bumps, but the open nature of cronartium and the visible evidence of pitch flow indicate that it is a serious defect.

A cronartium canker by itself is a scaled feature, as are other cankers, regardless of size. However, it sometimes covers heart rot, which is a degrading defect.

Crook and Fork

Crook has already been mentioned, but is listed again here since it is a scaled feature (fig. 13). Logs are usually bucked so as to eliminate crook, especially if it is in two planes. Serious cases of crook are normally left in the woods as cull or are bucked into short lengths for cordwood.

Crook is normally scaled out of the gross log volume, and the remaining net volume is graded as though the crook were not there.

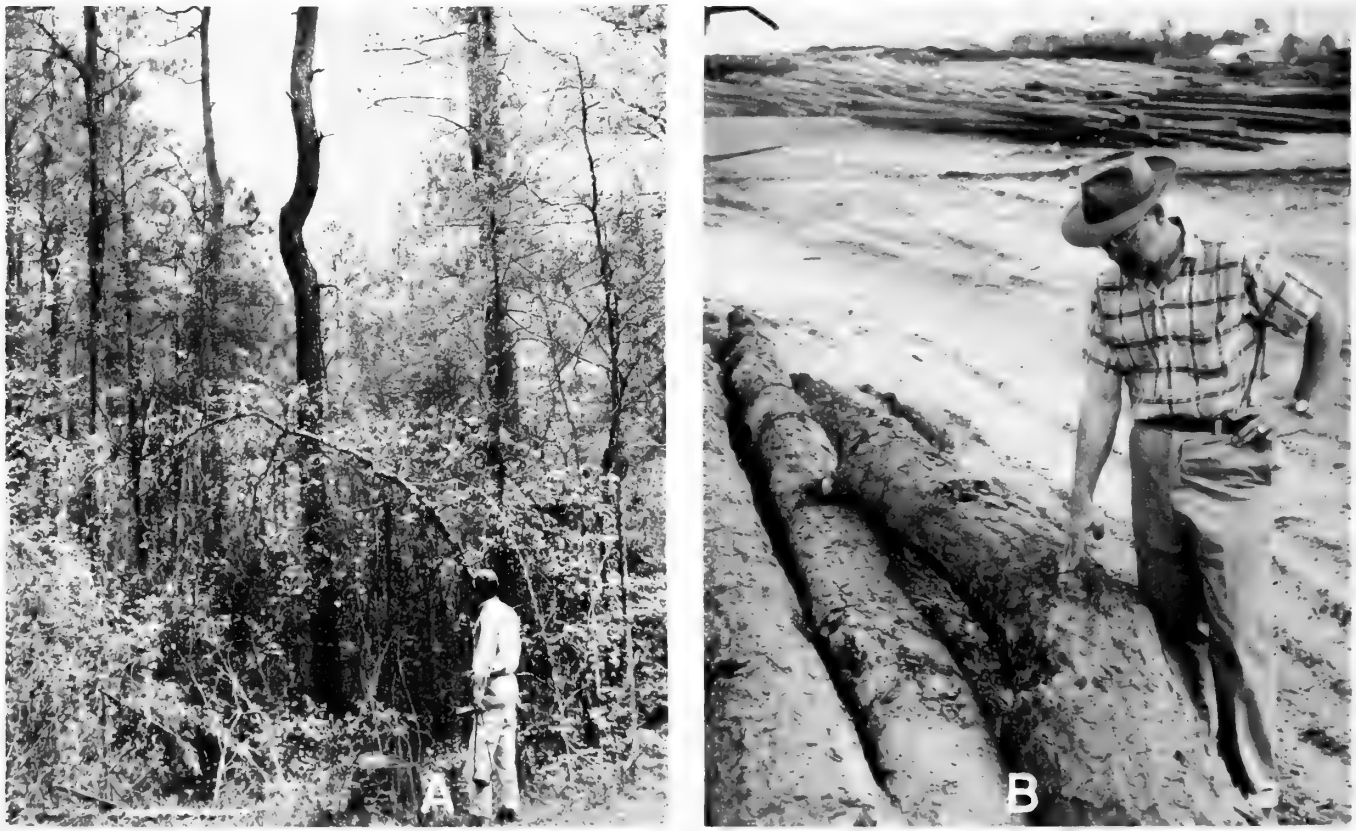
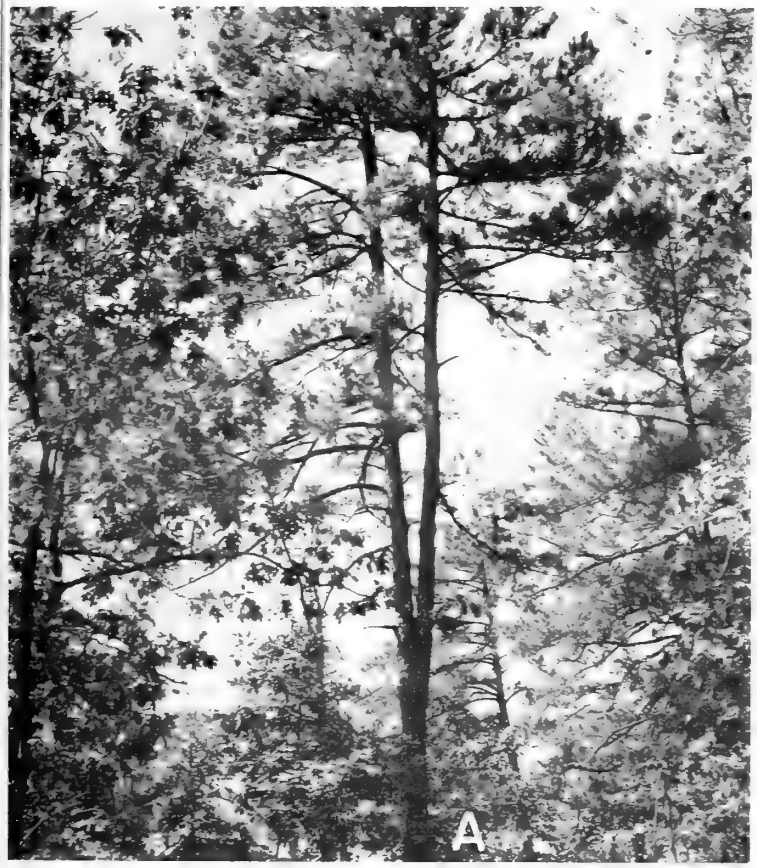
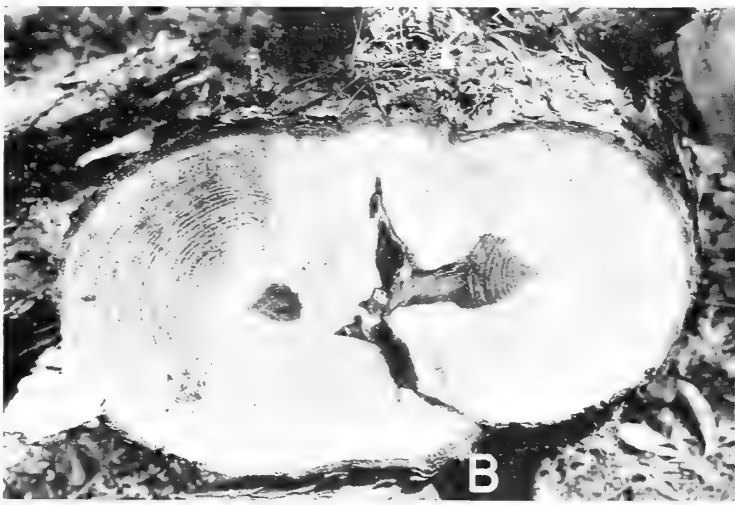


Figure 13.--Crook is especially serious if it exists in two planes. Because of cross grain and associated weakness, the affected portion is usually scaled out or left in the woods as cull material. A, crook in two planes in the tree. B, a crook in one plane is often left in the log despite scale deduction.

A fork is the portion of the log including parts of two or more tops (fig. 14A). Including a fork in the middle of a log is an operational error which sometimes results when logs are bucked to arbitrary lengths. On the other hand, some operators deliberately buck logs part of the way into forks (fig. 14B) in order to gain as much of the usable material as possible. Double pith and bark pockets are additional lumber defects associated with fork (fig. 14C). In the standing tree, a fork is considered to be either the end of merchantability or the beginning of a new log.





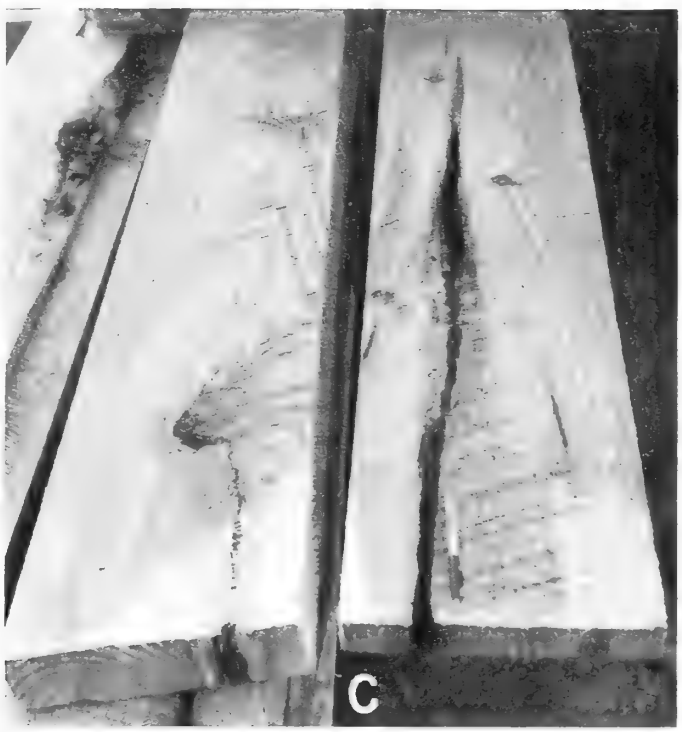


Figure 14. --Fork when left in the log, especially with included bark as in B, results in lower grade lumber. A, a fork as seen in the tree. B, fork with included bark. C, lumber from a fork as in B.

Injuries

Injuries are grouped here as biologically or mechanically caused, though it is sometimes difficult to distinguish between them.

1. Biological injuries included here are only those due to insects and those not already covered above (rot and canker).

Along with diseases, insects (figures 15 and 16) cause a great deal of damage to the southern pines. Sometimes Ips and Dendroctonus kill the tree outright within a growing season. In contrast, Ambrosia produce so little visible damage in trees or fresh cut logs (fig. 16A) that they are difficult to recognize. Losses caused by these insects can usually be scaled out, and are therefore listed as scaled features.

2. Mechanical injuries include shake (fig. 17A, B), splits (fig. 17C), and scars (fig. 18) or other logging damage. Most of this damage can be scaled out before the log is sawed into lumber.

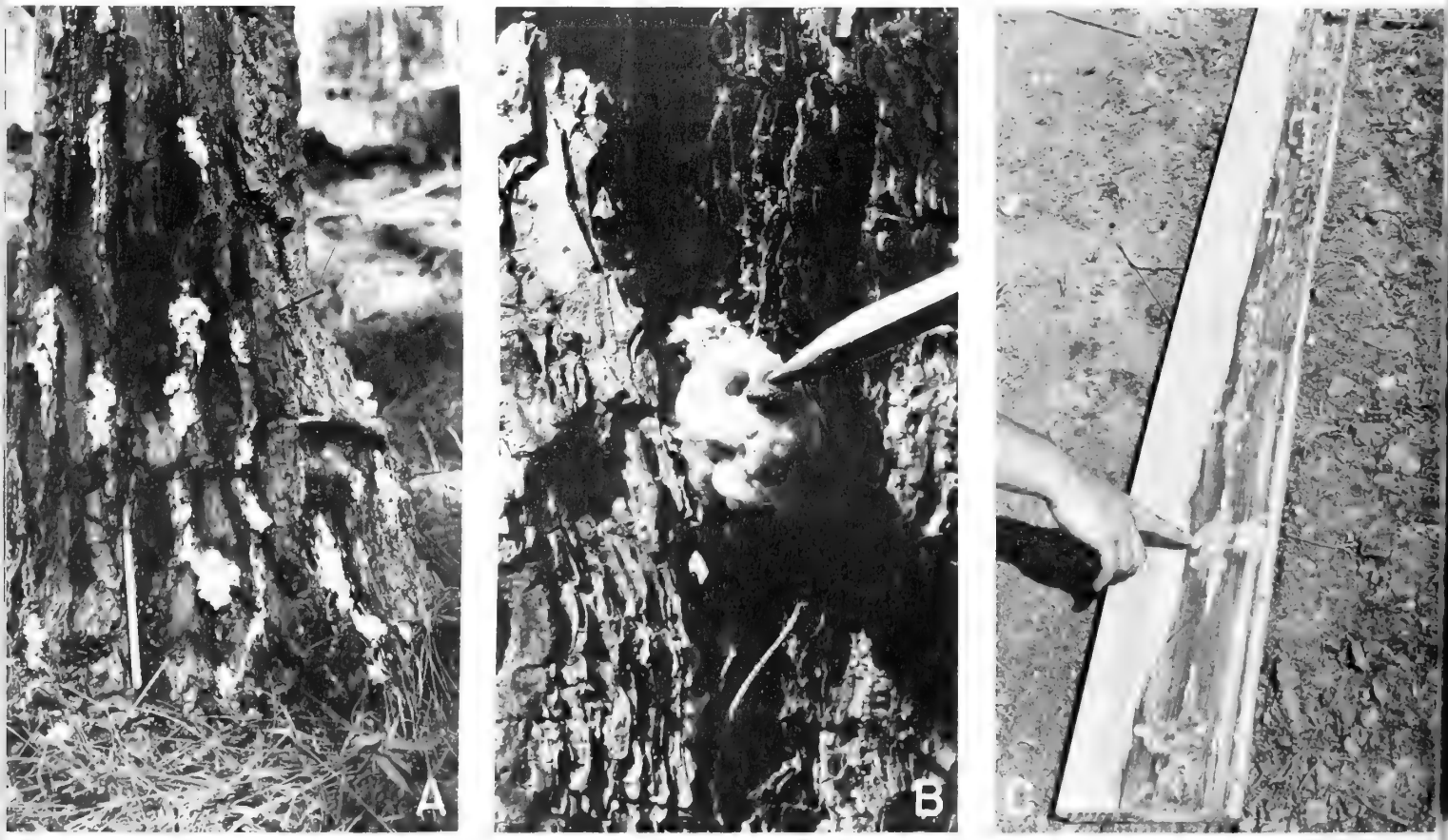


Figure 15. --Examples of turpentine beetle damage. A, pitch globs are beetle entrance holes in the tree trunk. B, closeup of entrance holes. C, grub tunnels weaken the lumber.

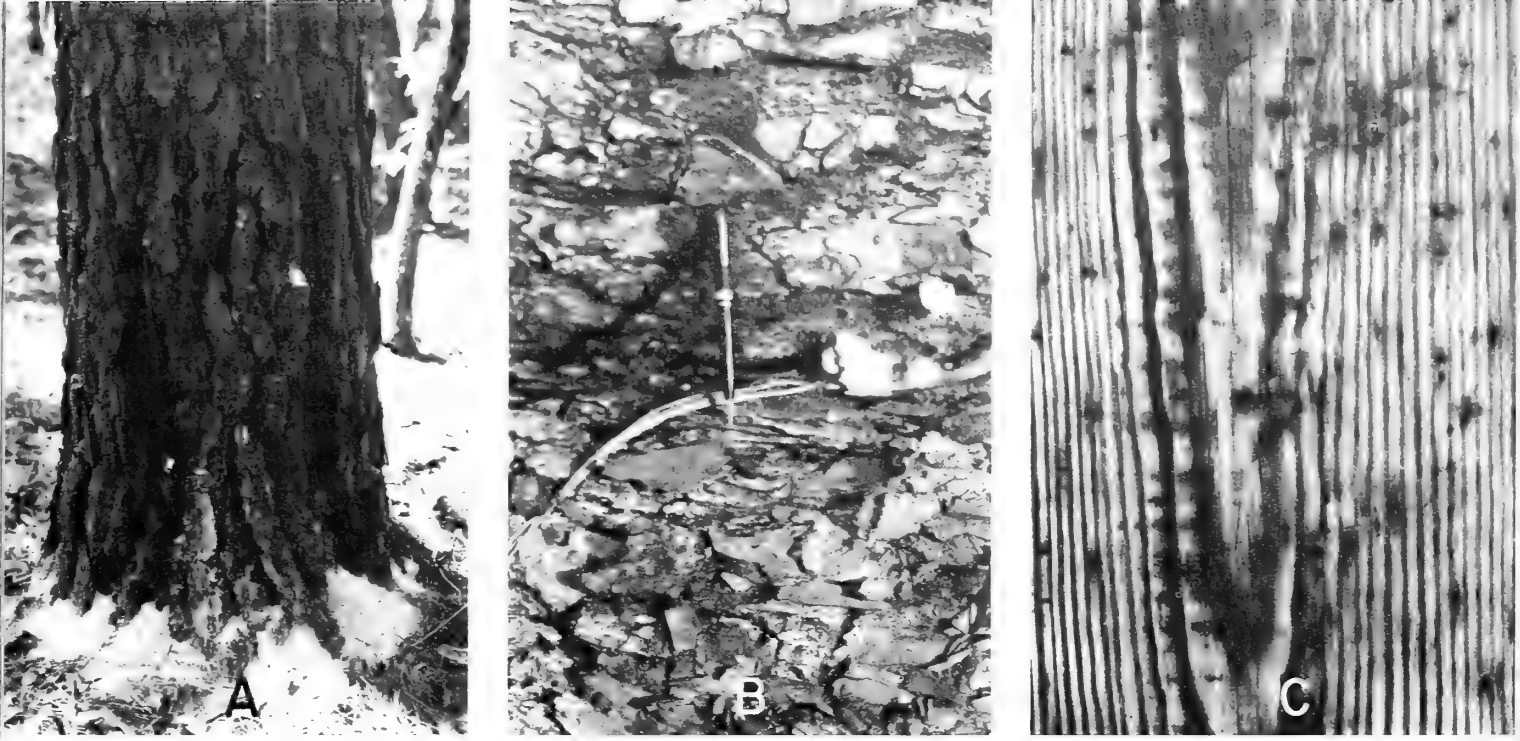


Figure 16. --Examples of Ambrosia beetle damage. A, the fine frass at base of tree indicates infestation. B, these insect holes are so tiny, they are easy to overlook in the log. C, their damage shows readily in the lumber.

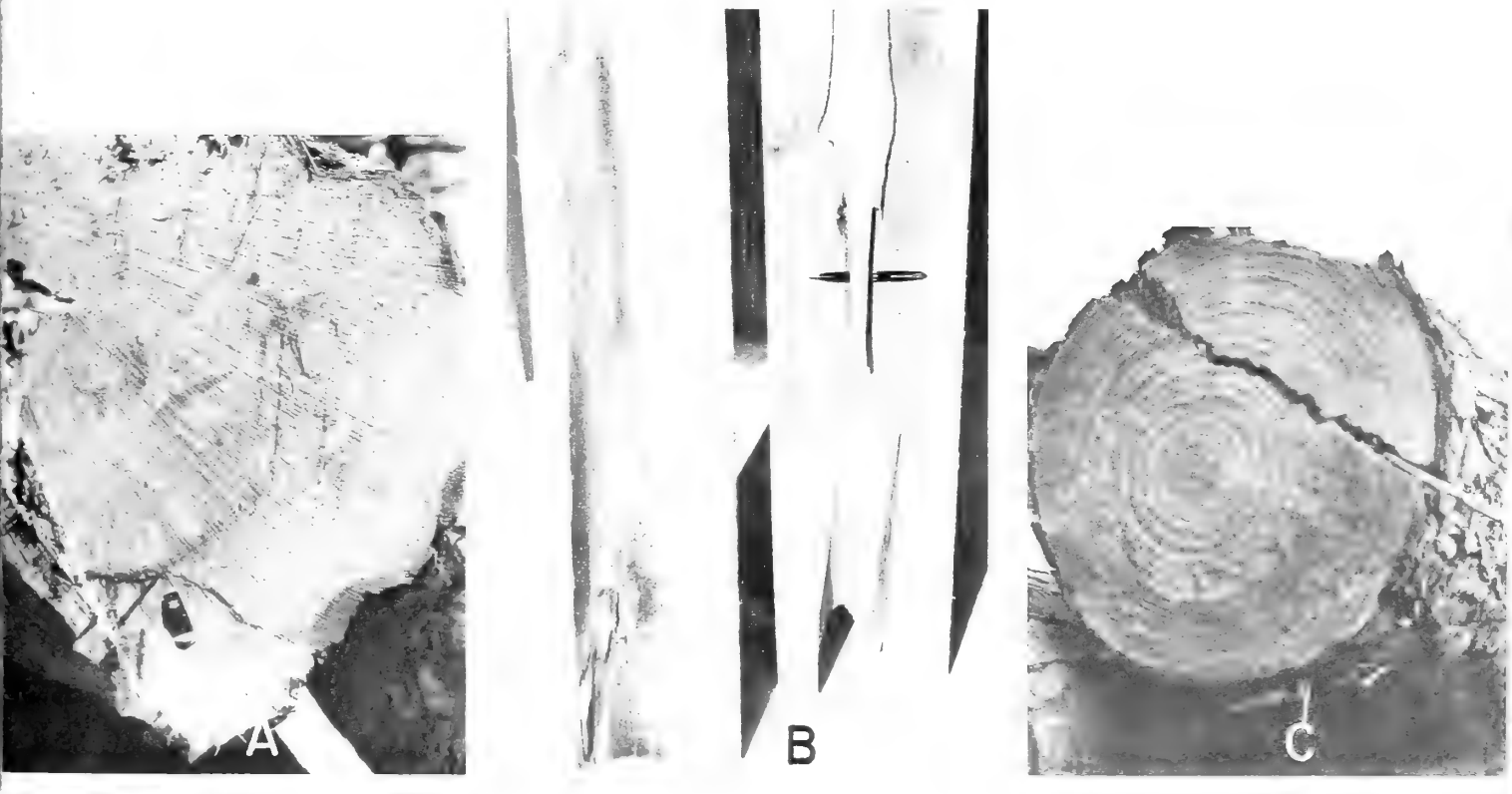


Figure 17. --Wind or ice damage can result in breaks in the log or tree which do not show up until the tree is felled, or sometimes until the log is sawed into lumber. A, observe shake at arrow tip. B, shaky lumber. C, split log.

Shake is a scaled feature which cannot be properly estimated until the tree is bucked into logs. It is a scale deduction because the affected boards will usually fall apart.

Splits are another scaled feature. They are caused usually by careless or accidental felling. Sometimes they result from severe wind or ice damage. In any case, the damage may be scaled out, but improper sawing may result in serious degrade.

A scar is an opening in the bark exposing sapwood and sometimes the heartwood (fig. 18B). It is also used here to include the evidence of older wounds partially or completely covered over by callus tissue. Common causes are fire, lightning, falling trees or limbs, and past logging damage.

Scars commonly affect lumber value indirectly; that is, their degrading effect is likely to be from associated blue stain, pitch, rot, bird work, or insect holes.

Figure 18.--Scars are evidence of old wounds. A, lightning scar, obviously serious, but a scalable deduction. B, fire damage, when as serious as this, is often followed by insects and disease. C, D, and E, examples of old wounds, but note the sound wood underneath.

This type of blemish can be recognized on the log surface or end, but it either does not affect lumber quality, or methods of accurately estimating its effect on log grades have not yet been devised. This category has been subdivided into major and minor features. The major ones, while not common, are the more important in affecting subsequent lumber values, whereas the minor ones have little or no effect on the lumber. These minor ones, however, are frequently encountered. No scale deductions are made for either class of log defect.

Major items include compression wood, pitch soak, and stain. The minor ones are adventitious limbs, ripples, small holes, and swells. Most minor irregularities are removed with the slab.

Compression Wood

Compression wood consists of abnormal growth resulting from tree lean. Pillow and Luxford 3/ have indicated that trees with five or more degrees of lean nearly always contain compression wood (fig. 19A). Compression wood is difficult to machine (fig. 19B, C). For this reason it is barred from the finish and stress grades of pine lumber.

It is a serious lumber defect, but to date there is no adequate measure of its effect on grade yield; hence, none on log grade.

Pitch Soak

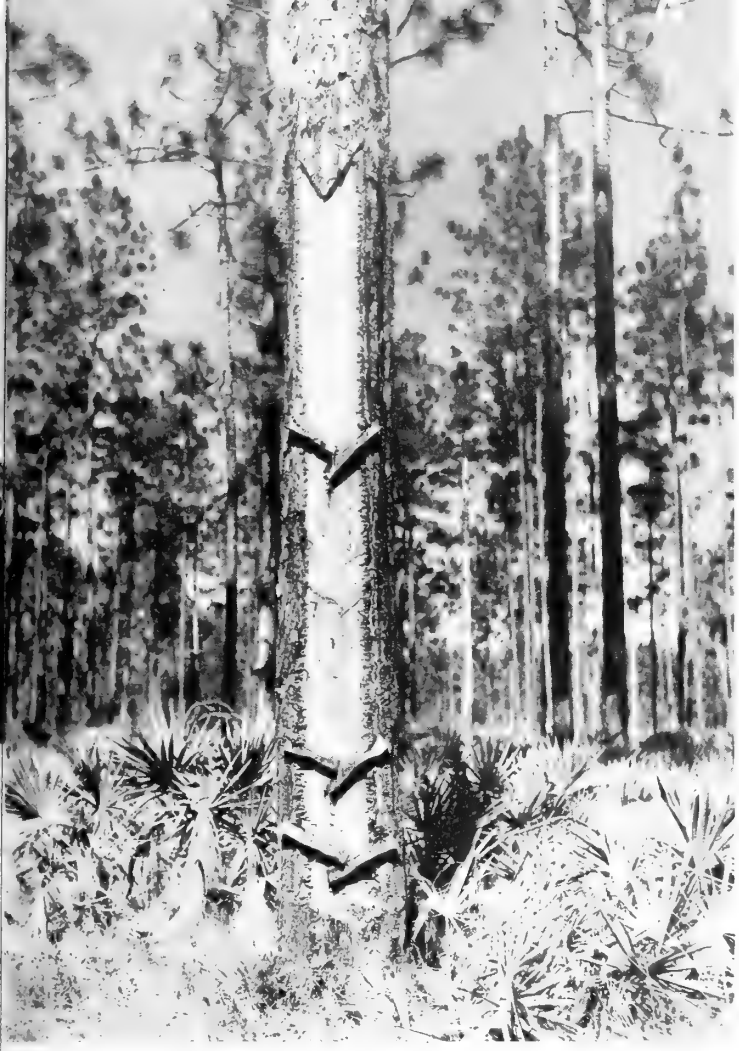
This is a localized defect found mostly in the gum-collecting areas of Georgia and Florida (fig. 20). Furthermore, it is much less serious now than formerly, because of improved naval stores practices. While pitch soak is a lumber defect, causing degrade in the finish grades, it affects such a small volume and is so difficult to predict that it is not considered in grading logs or trees.

Stain

Stain differs from rot in several ways. The principal difference is that it does not reduce the strength of the infected piece. Stain is not considered a defect in fresh logs. It is chiefly encountered around wounds. Except in logs and trees left in storage too long before sawing, it is of very minor importance.

3/ Pillow, M. Y., and Luxford, R. F. Structure, occurrence and properties of compression wood. U. S. Dept. Agr. Tech. Bul. 546, 32 pp., illus.

Figure 19. - - Compression wood is found in leaning and crooked trees. Ways to measure and express this lumber defect in the log and tree are being studied. A, an example of a leaning tree with compression wood. B, compression wood as it appears in the log. C, such lumber is difficult to surface and store.



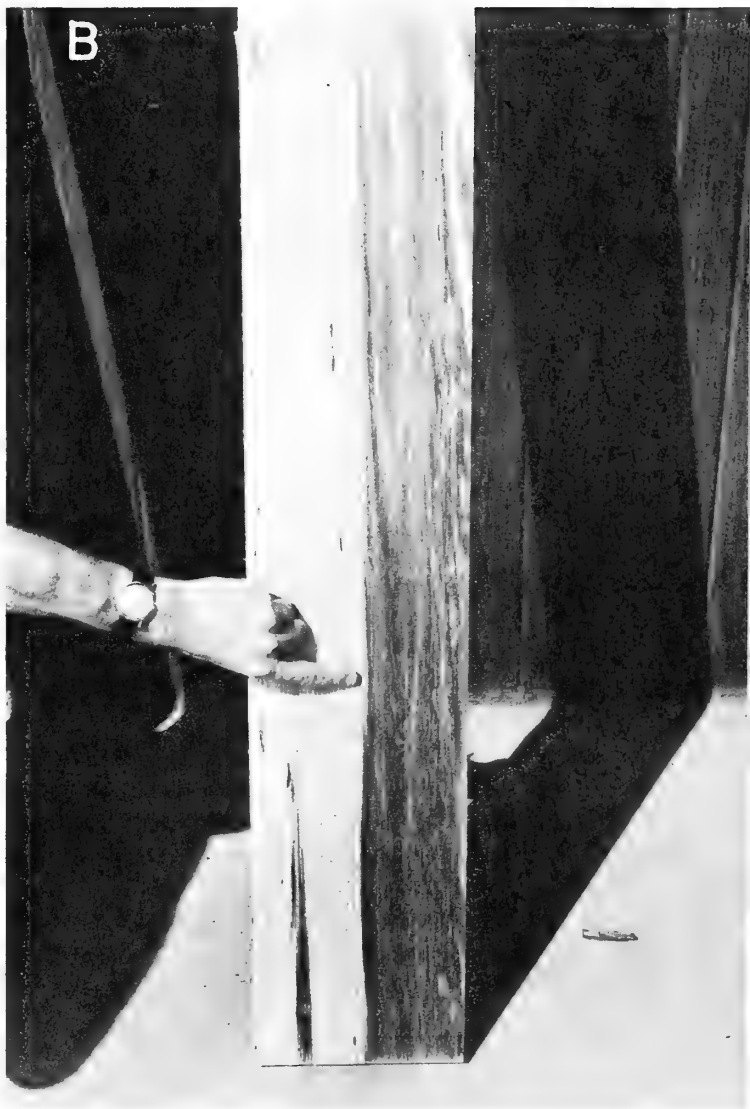


Figure 20. --Pitch soak is neither a log degrader nor ordinarily a lumber defect, but it does lower the lumber value in the finish grades. A, wood chipped face, formerly a common source of pitch soak. B, lumber containing pitch soak (dark portion of the board).

Adventitious Limbs

These are small limbs (less than $\frac{1}{2}$ inch in diameter) found on tree trunks below the normal crown (fig. 21). They do not have a heart center that extends to the pith of the log. They are more common on shortleaf than on the other four major southern pines. They frequently form on the trunks of trees following a heavy thinning or other opening operation. Under present marketing conditions, adventitious limbs are minor log defects, but this may well change if a pine veneer market develops.

Figure 21.--Adventitious limbs (those under $\frac{1}{2}$ inch in diameter) found below the normal crown; ignore in grading. A, shortleaf tree with adventitious "feathers." B, slash or longleaf "feather." C, same as B, just under bark. D, same as C, $1\frac{1}{2}$ inches under bark; note wood still is clear.

Bumps and Ripples

A bump is a protuberance on a log surface, covered or partly covered with wood and bark. Although it is usually rather small, a bump may occasionally cover an area 10 x 20 inches on a large tree. It is usually smoothly covered over, but may be partly open and exuding a little pitch. It can be defined as a surface abnormality that is clearly not a burl or a limb overgrowth.

In old open-grown yellow pine, bumps sometimes indicate an overgrown limb stub or a deeply buried knot. They are more likely to be associated with healed over, deeply buried scars, although a damaged or mangled limb when overgrown sometimes appears as a bump on the log surface. When several bumps occur on the same log, they may be more serious individually than if only one bump were present.

Ripples, in contrast to bumps, are usually numerous and provide a wave effect in the surface of the log or tree, as illustrated in figure 22A and B. They can be ignored in grading.

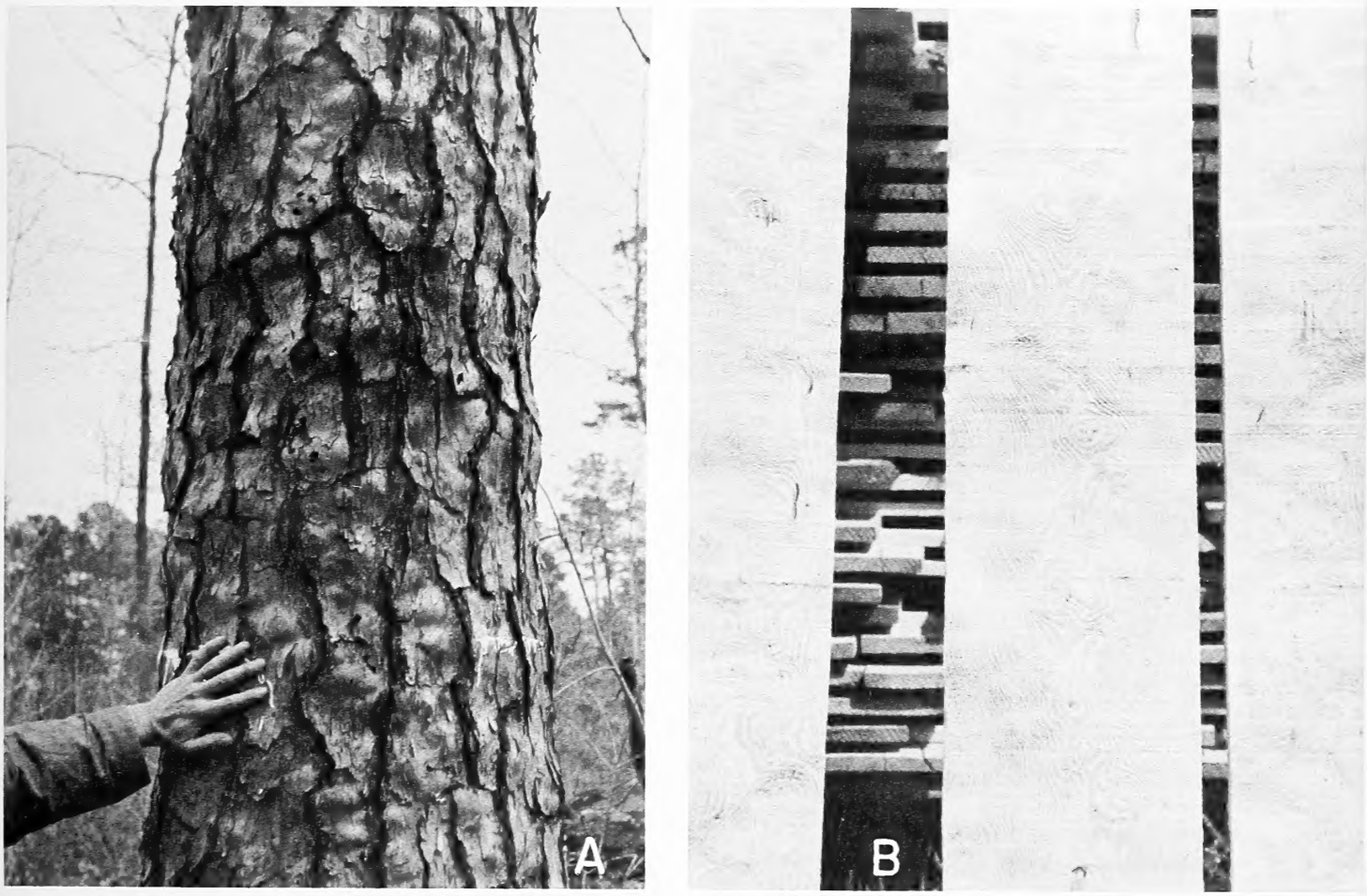


Figure 22.--Ripples provide a wavy effect in the log surface; they are ignored in grading. A, as seen in the tree. B, figured lumber from same tree.

Holes, Small

A small hole is an unoccluded or partially overgrown opening in the bark (not in a log knot), $\frac{1}{4}$ inch in diameter or smaller, which extends less than 2 inches into the wood of a tree. It is commonly caused by birds seeking insects in the tree bark, or by sapsuckers (fig. 23).

The small holes made by sapsuckers are usually confined to the bark, although they occasionally penetrate the wood slightly. They are usually found in horizontal bands or rows, but an occasional log may be freckled with them. They may produce small grain distortions or "bird's-eyes" in the lumber. Only rarely do dark, stained spots appear; this is in marked contrast to hardwoods, where associated stain and pockets of callus tissue are a major problem. When sapsucker attacks are severe, pitch flow may occur and pitch-related lumber defects may develop.

Swells

Neither butt nor stem swell in southern pines is common. This condition is usually caused by fire, or mechanical injury such as logging damage. Sometimes decay will cause an abnormal swelling on the stem. The causal agent is usually evident and the unsound volume, if any, can be scaled.

A flange is a protruding buttress-like structure at the base of a tree, extending outward beyond normal butt-flare or stump-flare. A flute is a convolution or fold running up and down the surface of a tree, but generally confined to the butt log. Neither is very common or important in yellow pine.

Figure 23. --Small holes such as these bird pecks can be ignored in grading.

SUMMARY

The chief grading factors used in determining the quality of southern pine logs and trees are diameter, straightness, and certain other external characteristics, especially knots, which indicate presence or absence of internal blemishes controlling product yield and hence the average value of the log or tree.

These "other characteristics" are classed as:

Degrading	Non-degrading
Knots (and large holes)	Scaled features
	cankers
Excess sweep	crook and fork
	insect and mechanical injuries
Conks (and red heart)	
	Features not scaled
	compression wood
	pitch soak and stain
	adventitious limbs
	ripples
	holes - small
	swells

The degrading features are the critical ones in grading logs and trees. Although the scaled items among the non-degrading are important economically because they reduce usable volume, their presence on a log or tree is insufficient cause for degrading it. The remaining not scaled but listed features are mentioned only because most of them are fairly common and their importance to grading is frequently questioned. All these items are pictured or described.

Softwood log and tree grades are still evolving; hence studies now in progress will provide further and more accurate information.

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